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sion. Only as an incident in the chapter on nutrition is it mentioned that foods temporarily stored in the chloroplasts must be transformed before removal, and implications of the same kind occur in connection with the general subject of the transfer of foods. But nowhere is there any discussion of the important part which digestion plays in plant life, nor any account of the agents by which it is accomplished.

It would not be difficult to point out minor inaccuracies here and there in Professor Peirce's book, nor unfortunate modes of expression; an illustration of the latter, and one very common in physiological writings, is repeated many times when he speaks of natural "laws" as though they were objective and efficient agents.

Professor Peirce's book contains so many excellent features that it is unfortunate to have it marred somewhat by sins of omission and commission. But all these matters may be rectified in future editions without fundamentally changing the character of the book, which will be useful to students, particularly if they have access to other books; and nowadays no student ought to get his physiological information from one source.—C. R. B.

Diffusion and osmotic pressure.

The rôle of diffusion and osmotic pressure in plants, by Dr. Livingston, is a well-made and attractive-looking volume of 149 pages, constituting one of the Decennial Publications of the University of Chicago.[2]

For several years the need of a concise, yet sufficiently detailed, statement of the facts and modern theories of diffusion and osmosis, on both the physical and the physiological side, has been felt by every student and teacher of physiology. Such a volume has now appeared.

Dr. Livingston has divided his book into two parts, one dealing with physical and the other with physiological considerations. In the first part we have Matter and its states, Diffusion and diffusion tension, Liquid solutions, Ionization, Osmotic phenomena, Measurement and calculation of osmotic pressure; and in the second part Turgidity, Absorption and transmission of water, Absorption and transmission of solutes, Influence of the osmotic pressure of the surrounding medium upon organisms.

After stating briefly the theories of matter, the author proceeds to the consideration of the diffusion of gases, liquids, and solids, and then in the following chapter discusses in a lucid manner the difficult subject of solutions, using this opportunity to repeat and apply the teachings of the preceding chapter on diffusion, and showing his regard for the needs of the student by defining such terms as *normal solution*, *gram-molecule solution*, and *gram-equivalent* solution.

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[2] LIVINGSTON, BURTON E., The rôle of diffusion and osmotic pressure in plants. Decennial Publications of the University of Chicago, Second Series, Vol. VIII. 8vo. pp. xvi + 149. University of Chicago Press. 1903. $1.50.

A brief discussion of the ionization of gases and of solutes in solution opens the way for a very satisfactory presentation of the general subject of osmosis, wherein the osmotic pressure of non-electrolytes, electrolytes and colloids is treated, and the means and methods of measuring and calculating the pressure are set forth with appropriate formulas.

Having laid a foundation in the physical, the author proceeds to the still more difficult physiological. To this part nearly a hundred pages are given. Only a few of the more striking topics can be mentioned here. Plasmolysis is shown to be not a matter of simple interpretation, as one would infer from literature generally, but a thing to be judged only after the permeability of the protoplasmic membrane is known. To determine the permeability various tests are detailed. The action of the protoplasmic membrane and the maintenance of turgidity in spite of permeability are two of the most interesting because most difficult theoretical discussions. It is evident that the author inclines to the solvent theory as applied to the action of the membrane in osmosis. In the chapters on the absorption and transmission of water and solutes, the means of lifting the sap to the tops of trees, and the means of exudation from water-pores, nectaries, etc., receive due consideration. These most difficult questions are not, as is too often the case, dismissed with the statement that there are no satisfactory explanations, but carefully and clearly the principal experimental results are recorded, their bearing pointed out, and their insufficiency noted. The pumping action of osmosis and the tensile strength of water are given as both probable means in the lifting of sap to great heights; while a change in the permeability of the protoplasmic sac is given as the possible cause of the beginning of excretion by water-pores and nectaries.

The last chapter represents in large measure original work by the author. Here are summarized his well-known experiments on the morphology of algae as influenced by the osmotic pressure of the surrounding medium. The work of Loeb, Massart, Rothert, and others, on the effect of osmotic pressure on irritability and in inducing parthenogenesis finds appropriate mention.

In the book as a whole there is little to criticise adversely and much to praise. Possibly the author pushes the theoretical a little too far sometimes, as, for example, in his explanation of the rise of a solution in a thistle-tube used as an osmometer. But it is better to state an insufficient hypothesis than to ignore all. In the reviewer's opinion one of the merits of the book is its abundance of theories clearly and boldly stated, while at the same time it points out the strength and weakness of each.

Pedagogically the treatment is excellent. The parts are well arranged, everything is interesting, a basis for the physiological is laid in the physical, there are copious citations of literature, and there are many suggestions as to problems for research. In the opinion of the reviewer Dr. Livingston has produced an excellent treatise.—FREDERICK C. NEWCOMBE.